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气助式直接喷射喷油器动态喷雾场数值模拟及试验

Numerical simulation and experiment on air-assisted direct injection injector dynamic spray field

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中文关键词: AADI喷油器 数值模拟 高速摄影 动网格 喷雾形态

英文关键词:AADI injector numerical simulation high-speed photography dynamic grid spray pattern

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中文摘要:

为了研究小型飞机发动机气助式直接喷射(air-assisted direct injection,AADI)喷油器喷雾形态及发展规律,采用数值模拟和高速摄影技术对其动态喷雾场进行研究.以锥阀运动的物理学模型为数值计算的移动边界条件,结合动网格技术对AADI喷油器动态喷雾场的速度分布、静动压分布和不同时刻雾化颗粒的空间分布进行动态数值模拟分析.以0.2ms为步长,对3.0ms内不同锥阀开启时刻的喷雾形态、雾化颗粒和贯穿距离进行了试验和仿真对比分析.结果表明:采用CFD仿真模拟技术可对AADI喷油器动态喷雾场的速度分布、压力分布、喷雾形态等参数进行定性分析,有利于揭示喷雾的发展规律,同时通过对喷雾粒径和贯穿距离的定量对比分析,表明了仿真计算的精确性,数值模拟计算与试验结果误差小于5%,满足工程应用的要求.

英文摘要:

In order to study the spray form and development law of the air-assisted direct injection (AADI) injector of small aircraft engines,numerical simulation and high-speed photography technology were used to study the dynamic spray field. The physics model of cone valve motion was defined as the moving boundary conditions of numerical calculation. The spray velocity distribution, static and dynamic pressure distribution and spatial distribution atomization particles at different times of AADI injector were analyzed by dynamic grid. The spray pattern, atomization and penetration were compared by experiments and simulations in 3ms every 0.2ms. Results show that CFD simulation technology was used to analyze velocity distribution, pressure distribution, spray pattern and other parameters of the dynamic spray field of AADI injector,helping to reveal the development rule of the spray; moreover, through quantitative comparison analysis of the particle sizes and penetration distance, the accuracy of simulation calculation was shown. The deviation of numerical simulation and experimental results is less than 5%, meeting the requirements of engineering applications.